

What is Claimed is:

1. An apparatus for determining arc fault energy in real time for a power circuit between a power source and a load, said apparatus comprising:
means for determining a value of voltage at said load;
means for determining a value of current flowing in said power circuit to or from said power source; and
means for determining a value of said arc fault energy from said value of voltage and said value of current.
2. The apparatus of Claim 1 wherein said means for determining a value of said arc fault energy includes means for determining a value of voltage at said power source.
3. The apparatus of Claim 2 wherein said means for determining a value of voltage at said power source includes a predetermined value of voltage at said power source.
4. The apparatus of Claim 1 wherein said means for determining a value of said arc fault energy includes means for determining a value of parallel arc power from said value of voltage at said load times said value of current, and means for determining said value of said arc fault energy as a function of an integral of said parallel arc power.
5. The apparatus of Claim 4 wherein said means for determining said value of said arc fault energy as a function of an integral of said parallel arc power includes means for integrating a difference of said parallel arc power less a decay rate.
6. The apparatus of Claim 5 wherein said means for integrating includes a constant value as said decay rate.
7. The apparatus of Claim 5 wherein said means for integrating includes a value proportional to said arc power as said decay rate.
8. The apparatus of Claim 5 wherein said means for integrating includes an output for said arc fault energy, a plurality of intermediate integration values, and means for setting any negative value of said arc fault energy and said intermediate integration values to zero.

9. The apparatus of Claim 2 wherein said means for determining a value of said arc fault energy includes means for determining a value of series arc power from said value of current times a difference of said value of voltage at said power source less said value of voltage at said load; and means for determining said value of said arc fault energy as a function of an integral of said series arc power.

10. The apparatus of Claim 2 wherein said means for determining a value of voltage at said load includes means for remotely communicating said value of voltage at said load to said means for determining a value of said arc fault energy.

11. A method for determining arc fault energy in real time for a power circuit between a power source and a load, said method comprising:
determining a value of voltage at said load;
determining a value of current flowing in said power circuit to or from said power source; and
determining a value of said arc fault energy from said value of voltage and said value of current.

12. The method of Claim 11 further comprising:
determining a value of parallel arc power from said value of voltage times said value of current; and
determining said value of said arc fault energy as a function of an integral of said parallel arc power less a decay rate.

13. The method of Claim 12 further comprising:
employing one of a value proportional to said parallel arc power and a constant value as said decay rate.

14. The method of Claim 12 further comprising:
determining a plurality of intermediate integration values before outputting said arc fault energy; and
setting any negative value of said arc fault energy and said intermediate integration values to zero.

15. The method of Claim 11 further comprising:
determining a value of voltage at said power source;

determining a value of series arc power from said value of current times a difference of said value of voltage at said power source less said value of voltage at said load; and

determining said value of said arc fault energy as a function of an integral of said series arc power.

16. An apparatus for determining a location of a parallel arc for a power circuit between a power source and a load in real time, said apparatus comprising:

means for providing a value of voltage from said power source;
means for measuring a value of current flowing in said power circuit to or from said power source;

means for measuring a value of voltage at said load; and
means for determining said location from said value of voltage from said power source, said value of current, said value of voltage at said load, and a wire resistance per unit length or a wire conductance per unit length of said power circuit.

17. The apparatus of Claim 16 wherein said means for measuring a value of voltage at said load includes a first circuit encoding said value of voltage at said load on a power line carrier; and wherein said means for determining said location includes a second circuit decoding said value of voltage at said load from said power line carrier.

18. The apparatus of Claim 16 wherein said means for measuring a value of voltage at said load includes a first circuit sending said value of voltage at said load on a communication channel; and wherein said means for determining said location includes a second circuit receiving said value of voltage at said load from said communication channel.

19. The apparatus of Claim 18 wherein said communication channel is a wireless media.

20. The apparatus of Claim 17 wherein said first circuit includes a series combination of a switch and a resistor electrically connected in series with said switch, and a third circuit driving said switch at a predetermined frequency, said series combination being electrically connected between said power circuit and a

ground in order to switch a current at said predetermined frequency in said power circuit, said switched current being representative of said measured value of voltage at said load; and wherein said second circuit includes a fourth circuit decoding said switched current at said predetermined frequency in said power circuit and representative of said measured value of voltage at said load in order to determine said measured value of voltage.

21. The apparatus of Claim 20 wherein said third circuit is a multivibrator, and wherein said switch is a transistor driven by said multivibrator.

22. The apparatus of Claim 20 wherein said first circuit further includes a diode electrically connected in series with said resistor and said switch.

23. The apparatus of Claim 17 wherein said first circuit includes a series combination of a diode electrically connected in series with a resistor, said series combination being electrically connected between said power circuit and a ground.

24. The apparatus of Claim 16 wherein said means for determining said location includes a processor determining said location from a difference of said value of voltage from said power source less said value of voltage at said load, said difference being divided by said value of current and being divided by said wire resistance per unit length.

25. The apparatus of Claim 24 wherein said processor employs a predetermined source voltage as said value of voltage from said power source.

26. The apparatus of Claim 16 wherein said means for determining includes means for adjusting said location based upon a resistance of connectors in said power circuit.

27. A method for determining parallel arc location in real time for a power circuit between a power source and a load, said method comprising:

providing a value of voltage from said power source;

measuring a value of current flowing in said power circuit to or from said power source;

measuring a value of voltage at said load; and

determining said parallel arc location from said value of voltage from said power source, said value of current, said value of voltage at said

load, and a wire resistance per unit length or a wire conductance per unit length of said power circuit.

28. The method of Claim 27 further comprising:
employing a predetermined source voltage as said value of voltage from said power source.
29. The method of Claim 27 further comprising:
measuring a source voltage as said value of voltage from said power source.
30. The method of Claim 27 further comprising:
determining a difference of said value of voltage from said power source less said value of voltage at said load; and
dividing said difference by said value of current and by said wire resistance per unit length.
31. The method of Claim 27 further comprising:
employing a total predetermined length of the power circuit from the power source to the load;
employing a nominal value of load current; and
determining said parallel arc location from said value of voltage from said power source, said value of current, said value of voltage at said load, said wire resistance per unit length or said wire conductance per unit length of said power circuit, said total predetermined length of the power circuit from the power source to the load, and said nominal value of load current.
32. An apparatus for distinguishing a parallel arc from a series arc for a power circuit between a power source and a load, said apparatus comprising:
means for providing a nominal value of current flowing in said power circuit between said power source and said load;
means for providing a measured value of current flowing in said power circuit to or from said power source; and
means for identifying said parallel arc when said measured value of current is greater than said nominal value of current, and for identifying said series arc when said measured value of current is less than said nominal value of current.

33. The apparatus of Claim 32 wherein said means for identifying includes means for determining arc fault energy of said parallel arc or of said series arc.

34. The apparatus of Claim 32 wherein said means for identifying includes means for determining location of said parallel arc.

35. The apparatus of Claim 32 wherein said means for identifying includes means for identifying said parallel arc and said series arc only when a ratio between a voltage at said load and a voltage at said power source is less than a predetermined percentage.

36. The apparatus of Claim 35 wherein said predetermined percentage is about 80%.

37. The apparatus of Claim 35 wherein said means for identifying further includes means for identifying said parallel arc when said measured value of current is greater than about two times said nominal value of current.

38. The apparatus of Claim 35 wherein said means for identifying further includes means for identifying said series arc when said measured value of current is less than or equal to about 0.8 times said nominal value of current.

39. The apparatus of Claim 38 wherein said means for identifying further includes means for identifying said series arc when said measured value of current is greater than or equal to about 0.2 times said nominal value of current.

40. A method for distinguishing a parallel arc from a series arc for a power circuit between a power source and a load, said method comprising:

providing a nominal value of current flowing in said power circuit between said power source and said load;

providing a measured value of current flowing in said power circuit to or from said power source; and

identifying said parallel arc when said measured value of current is greater than said nominal value of current, and alternatively identifying said series arc when said measured value of current is less than said nominal value of current.

41. The method of Claim 40 further comprising:
 - employing said measured value of current being greater than said nominal value of current and identifying said parallel arc;
 - determining a value of voltage at said load;
 - determining a value of parallel arc power from said value of voltage times said measured value of current flowing in said power circuit to or from said power source; and
 - determining a value of parallel arc fault energy as a function of an integral of a difference of said parallel arc power less a decay rate.
42. The method of Claim 40 further comprising:
 - identifying said parallel arc and said series arc only when a ratio between a voltage at said load and a voltage at said power source is less than a predetermined percentage.
43. The method of Claim 42 further comprising:
 - employing as said predetermined percentage about 80%.
44. The method of Claim 40 further comprising:
 - identifying said parallel arc when said measured value of current is greater than about two times said nominal value of current.
45. The method of Claim 40 further comprising:
 - identifying said series arc when said measured value of current is less than or equal to about 0.8 times said nominal value of current.
46. The method of Claim 45 further comprising:
 - identifying said series arc when said measured value of current is greater than or equal to about 0.2 times said nominal value of current.